Creep and Microstructural Coarsening of Lead Free Solders

DMR Award 0209464 (GOALI Program with INTEL Corp.)

PI : Indranath Dutta, Naval Postgraduate School, Monterey, CA

MOTIVATION

- Solder joints are a critical part of a microelectronic package (e.g., INTEL Pentium microprocessor)
- Solders undergo extensive creep deformation and microstructural changes during service
- Limits performance and reliability of chip / package
- These phenomena not understood for the new lead-free solders which will be introduced commercially by 2006 to address global environmental concerns

GOAL

- Understand creep / coarsening of lead-free solders
- Develop microstructurally adaptive creep models to facilitate accurate life prediction

KEY ACCOMPLISHMENTS

- Developed apparatus for testing life-sized solder balls : Technology is being transferred to INTEL
- Results disseminated through 5 journal articles

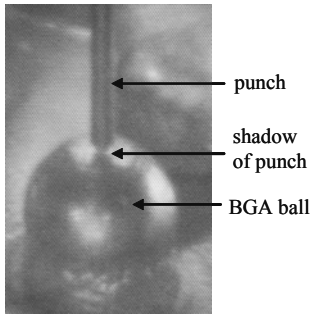
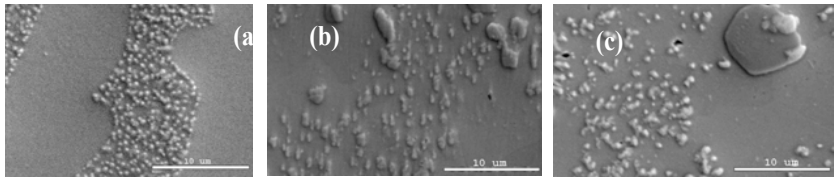
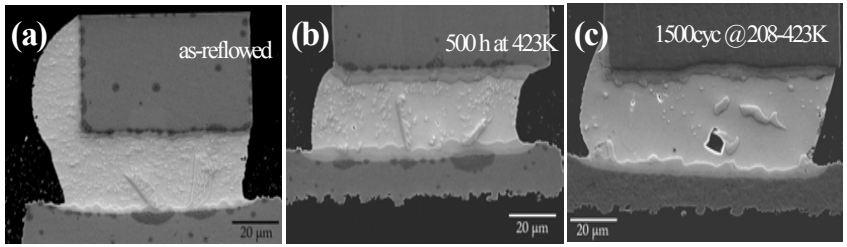


Photo of a 750µm diameter microelectronic solder ball being tested using a 100µm diameter loading punch (live photo obtained using video system of impression creep test apparatus)



Microstructural changes in a 750µm diameter microelectronic solder ball due to prolonged thermal exposure.



Microstructural changes in a 60µm diameter microelectronic solder ball attached to a chip due to thermo-mechanical excursions.

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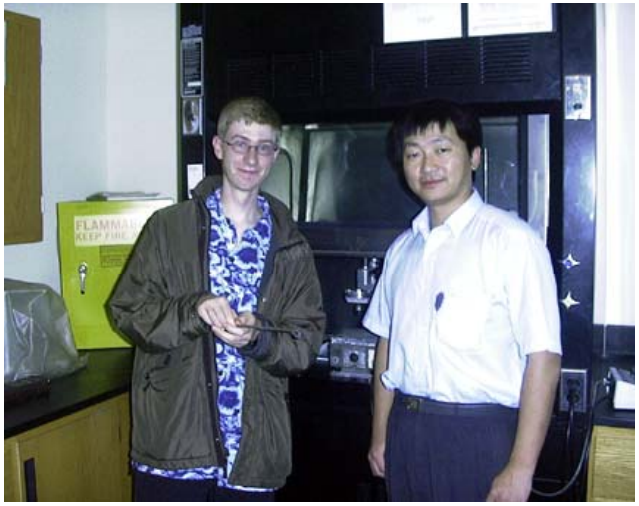
TRAINING

- 2 graduate students (Elroy Crocker and John Walsh) have participated
- 2 post-doctoral associates (Dr. Deng Pan and Dr. Shuwei Ma) are participating
- Materials engineer, Dr. Chanman Park, postdoctoral associate Dr. S. Choi, and postdoctoral associate Dr. Robert Marks were trained in high resolution mechanical testing. Dr. Choi is currently with Samsung Electronics, and Dr. Marks is at UC Berkeley.



High School student Nick Vlahos and Postdoctoral associate Dr. Deng Pan working at a fume hood to prepare metallographic samples of solder

OUTREACH

- Prof. Dutta served as a mentor for an internship program administered by the Monterey Academy for Oceanography and Sciences (MAOS), through which a high school student, Nicholas Vlahos, participated in the project during the summers of 2003 and 2004. Last year, Mr. Vlahos learned how to prepare samples for optical and scanning electron microscopy. This year, he learnt quantitative microscopy and statistical analysis of solder microstructures subjected to thermo-mechanical excursions.